UNEMPLOYMENT INSURANCE AND ITS EFFECTS ON DURATION OF UNEMPLOYMENT SPELL

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SUMMARY

The effect of Unemployment (UI) on Unemployment Duration (UD) is widely investigated with job search theory, which tells that the possibility of transiting from unemployment to employment is determined by two factors—job arrival rate and the possibility of accepting the job offer. Some economists think that UI reduces the search cost and income loss for unemployed workers, which increases the reservation wage and lengths their UDs. While some economists think that UI can support job search and increase the job arrival rate as well. This makes its impact on UD ambiguous.

The theoretical framework of this paper is based on Mortensen (1986). In Mortensen's model, search cost is exogenously determined and does not change over time and the job offer arrival rate is fixed. This paper assumes that job arrival rate is positively correlated with search cost and that unemployed workers can choose their search cost to maximize their value of unemployment. The individual asset is used as a proxy for financial resources and introduced into budget constraint. The theoretical model shows the possibility that the effect of UI on UD varies with the individual asset. For unemployed workers with limited asset the effect of UI on transition from unemployment to employment is positive; for unemployed worker whose asset is over certain amount, the effect becomes negative. It is assumed that value of leisure is positively correlated with individual asset, and inferred that the transition rate from unemployment to employment first increases with asset but then decreases.

The theoretical predictions are tested using both parametric and semi-parametric survival models. Using the U.S. National Longitude Survey of Youth 1979, I find that UI can reduce UD for poor unemployed workers. The empirical results are not sensitive to semi-parametric and parametric analysis, which implies that the empirical result is robust. In addition, the results of this paper suggest that poor unemployed workers should be given more subsidies to help job search and UI benefits for rich unemployed workers should be taxed to reduce their UD.

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CHAPTER 1

INTRODUCTION

The effect of unemployment insurance (UI) on unemployment duration (UD) has been widely investigated in the past 30 years. One of the most commonly used models to analyze the impact of UI on UD is job search theory, where the probability of reemployment is influenced by two factors: (1) the job arrival rate and (2) the possibility of accepting the offer. The evolution of job search theory has had a profound impact on labor market transition analysis. The theory provides economists with an analytical tool to explore rational individual behavior during unemployment. The theoretical contributions have greatly influenced empirical work on unemployment in general, and microeconometric work on unemployment duration in particular.

Many researchers focus on the possibility of accepting the offer. Mortensen (1970, 1977) points out that UI would reduce the search cost and income lose of unemployed worker, which increases the expected return from job search and the reservation wage[1] and hence lengthens UD. In addition, many previous empirical studies find that UI prolongs UD. Reviewing some micro-data studies in the US, Danziger, Haveman, and Plotnick (1981) [p.992] find a positive relationship between UI and UD which "appears robust". Lancaster and Nickell (1980) find that the elasticity of unemployment duration with respect to unemployment benefits is about 0.6, which means that a 10 percent rise in benefits will be associated with a one week rise in UD if the duration is 17 weeks. These

[1] Reservation wage means the minimum wage rate of job offer at which unemployed worker is willing to accept the job offer.

estimations suggest that only quite large cuts in benefits could raise outflows sufficiently to reduce unemployment by a substantial amount.

Most of the papers ignore the potential impact of UI on the job arrival rate. The job arrival rate depends not only on the labor demand in particular labor market and personal characteristics, but also on the job search effort. Maki and Spindler (1975) point out that increases in unemployment benefits will induce a greater search activity. Wadsworth (1991) shows that the unemployment benefits indeed have a positive effect on job search activities and reduce UD. Using UK Labor Force Survey data, he estimates search effort equations conditional on the decision to look for jobs. After controlling for potential selectivity bias, personal characteristics and demand conditions, he finds that unemployed workers with UI benefits search more extensively than Non-UI receivers, thereby increasing the job arrival rate.

The findings of these papers have important implications for the study of impact of UI on UD. If UI benefits help individuals to search more intensively and increase the job arrival rate, the effect of UI on expected UD is ambiguous. This paper attempts to examine both theoretical and empirical link between UI on UD and suggests that the impact of search cost on job arrival rate should be considered when investigating the impact of UI on UD. In the next section, the theoretical framework is introduced, which first reviews the previous findings, then briefly describes Mortensen's model (1986) and extends the model by adding some assumptions. Section 3 develops the empirical model. Section 4 discusses the data source. Section 5 reports the estimation results. Section 6 provides some implications and policy applications and section 7 concludes.

CHAPTER 2

THEORETICAL FRAMEWORK

2.1 Literature Review

Job search theory is one of the most recently and frequently used models in analyzing the transition from unemployment to employment. It provides a framework to investigate the problems of transition and is used to analyze the impact of UI on UD in this paper.

In the standard job search model, the job arrival rate and distribution of offered wages are exogenously determined and the strategy of the unemployed worker is to choose an optimal reservation wage. This theory says that for UI receivers, an increase in the benefits rate lowers cost of search and increases the reservation wage, resulting in longer expected duration of unemployment. Mortensen (1977, 1986) derives several strong results using a model of sequential search where he incorporates some institutional features of labor markets, such as a fixed duration of benefits payments and an eligibility requirement that a certain amount of work experience must precede insured unemployment. The wage-offer distribution is taken as stationary and known by job seekers. He concludes that for unemployed workers who are eligible for benefits, a rise in the benefits level will cause them to increase their reservation wage; but when it is close to benefits exhaustion, the insured workers will reduce their reservation wage. The exit rate is thus lower for newly unemployed workers but higher for workers whose benefits are close to exhaustion.

Ham and Rea (1987) apply a discrete-time-duration model to Canadian microeconomic data to examine the effect of UI onUD. They control for the UI benefits duration and demand conditions to examine their impacts on the probability of leaving unemployment. Their result indicates that the UI benefits duration has a significant effect on unemployment duration, even for those who do not ultimately exhaust their benefits. If UI benefits duration is fixed, the probability of leaving unemployment declines with duration of unemployment. When UI benefits duration is added into the model, the probability of leaving unemployment first falls and then generally rises with unemployment duration. Within the context of the search model, a decline in UI benefits duration induces a greater willingness to accept offers or to search more intensively. If transition rate is the same for UI receivers and Non-UI receivers after UI expires, the expected UD will be longer for UI receivers than for Non-UI receivers.

Meyer (1990) tests the effects of the level and length of UI benefits on unemployment duration. The paper particularly studies individual behavior during the weeks just prior to when benefits lapse and find that transition rate rises dramatically just prior to when benefits lapse. When UI benefits duration is extended, the probability of a spell ending is high in the week when benefits were previously expected to expire. The author also finds that higher UI benefits have a strong negative effect on the probability of leaving unemployment.

At the same time, many economists explore the incentive effect of UI on transition. Tannery (1983) says that if time spent and market expenditures are complementary inputs in job search the total effect of UI may be ambiguous. The author bases his theory on the Barron and Mellow (1979). One of the more interesting features of the theoretical framework developed by Barron and Mellow (1979) is that job seekers are assumed to choose their input of time and expenditures to affect the job arrival rate in any period. However, Barron and Mellow assume that these inputs of time and market goods are combined to determine job arrival rate separately—the level of market expenditures does not affect the marginal productivity of search time. Barron and Mellow show that search effort decreases with the increase in reservation wages, which is caused by UI benefits. Tannery (1983) shows how relaxing this assumption alters the basic prediction from Barron and Mellow (1979). He assumes a more general function for job arrival rate, indicating that search expenditures and search time are complementary inputs. If this is the case, increases in income will result in search expenditure increase, which will raise the productivity of time spent in search and induce greater search efforts. Then a priori potential for UI benefits to encourage search effort is expanded because UI might encourage unemployed worker to allocate greater search expenditure on search activities. He uses empirical result to confirm that after taking the complimentary relationship between time devoted to job search and search cost into consideration, UI has positive effect on job transition, which casts some doubt on Barron and Mellow's conclusion.

Similarly if there are binding restrictions on the capacity of unemployed workers to borrow to finance search activity, UI would possibly increase the resources devoted to search and hence increase the probability of return to work. Ben-Horim and Zuckerman (1987) show that for individuals with limited private resources for search purposes, UI benefits could decrease the expected UD. They add search cost into the job distribution and define the distribution function of the highest wage offer received over each period as F_c , where c is the periodic search cost. An increase in the search cost causes a stochastic increase in the number of offers received per period. Therefore, they assume that F_c is an increasing function of c. In addition, they make search intensity endogenously determined—the individual choose how much financial resources are used for job search to maximize the expected return from search. Under these assumptions, they find that for unemployed workers with limited financial resources, UI benefits can reduce the expected UD. In addition, they give an example to show that there exists such a possibility. Their example shows that when the highest possible wage offer is large enough, UI reduces the expected UD.

Kahn and Low (1988) have considered types of search, as opposed to search intensity. In their search model, unemployed workers are seen as choosing between systematic search, which involves collecting information on the wages offered by specific search, and random search where job searcher elicits offers from a distribution that is known a priori but the searcher is ignorant of the particular offer that any firm will make. Previous theoretical models of job search assume either that the searcher has no firm-specific information and thus searches randomly or that the searcher has firm-specific knowledge and choose which firms to contact. Kahn and Low build and test a theoretical model that involves both systematic search and random search. In their model, job seeker can produce firm-specific knowledge which can be productively used in looking for a new job. Systematic search is assumed to be costly in both time and money but is more likely to lead to an acceptable wage offer. UI benefits increase the financial resources of job seekers, hence increase the likelihood of producing firm-specific information and search systematically. Using the 1976 US Current Population Survey (CPS) data, they find that offers are more likely to be rejected in random search strategy than under systematic search and UI does subsidize systematic search. Kahn and Low's model of systematic search shows that UI encourages unemployed workers to structure job search so that the job seeker contacts firms, which leads to higher possibility of finding a job. Therefore UI can reduce the expected UD.

Hughes, Peoples and Perlman (1996) compare the transition of unemployment between high-income and low-income group to exam whether the UI benefits help unemployed workers to find jobs more efficiently. Their paper assumes that the high-income group and low-income group are faced with different labor market. For unemployed workers in low-income group, the labor market provides limited opportunities for them, which means that searching for job longer cannot bring better job offers, while for unemployed workers in high-income group, the labor market provides more opportunities, which makes it possible to get better job if unemployed workers search for a longer time. Based on this assumption, the authors conclude that if UI works efficiently, UI induces the UI receivers in high-income group to search longer than UI receivers in the low-income group. They use simple OLS regression to check their theoretical result, taking unemployment duration as dependant variable and controlling for other demographic characteristics, labor market situations and UI. Their empirical result agrees with their theoretical inference, although within low-income and high-income group, UI receivers have a longer UD than their counterparts.

The above job search models suggest that it is possible that UI has positive effect on job search and reduces UD. Holzer (1988) shows that the number of job search methods used to find job is affected by income sources. Wadsworth (1991) shows that mean number of search method used by benefits receivers is 3.16 and is only 2.36 by non-benefit receivers. If there is a positive correlation between job arrival rate and number of search method, it is possible that UI can increase the transition rate of reemployment.

2.2 Theoretical Model

2.2.1 Mortensen's Model

Mortensen (1986) mainly focuses on the transition from unemployment to employment. According to Mortensen's model[2] at each period,

$$rV = b - c + \lambda \int_0^\infty \max[0, W(x) - V]\,dF(x)\,, \qquad (1)$$

where V is the value of unemployment, r is the interest rate, b-c is the unemployment income, and b is the value of leisure, c is the search cost; $\lambda \int_0^\infty \max[0, W(x) - V]\,dF(x)$ is the expected income from job search, λ is job arrival rate, $W(x)$ is value of job if unemployed workers accept the job offer, and $F(x)$ is the distribution of job offers.

[2] The detail is referred to Mortensen (1986).

Equation 1 tells that the imputed income derived from the value of unemployment per unit time period is equal to the unemployment income plus the expected income gain from job search. Since the present value of a future earning stream given a wage equal to x is $W(x) = x/r$, and the reservation wage is equal to imputed value of unemployment,

$$rV = rW(w^*) = w^* \qquad (2)$$

To recover the fundamental reservation wage equation for this model, simply use equation 2 to eliminate V in equation 1 and let $W(x) = x/r$, and the result becomes,

$$(\lambda / r)\int_{w^*}^{\infty}[x - w^*]dF(x) = c + w^* - b. \qquad (3)$$

The left-hand side is the expected present value of return from job search and the right-hand side is the cost of search this period when reservation wage is offered. Therefore, the rational policy for search is reached when the benefit of job search is equal to the cost of job search. Given a stationary reservation wage, w^* and job arrival rate, λ, the probability at which unemployed workers escape unemployment is simply

$$\phi = \lambda[1 - F(w^*)], \qquad (4)$$

which means that the transition rate from unemployment is the product of job arrival rate and the possibility of accepting the job offer $[1 - F(w^*)]$.

2.2.2 Extension of Mortensen's Model

Two assumptions are added into Mortensen's model. The first assumption is that the job arrival rate is positively correlated with search cost and the marginal effect of search cost on job arrival rate diminishes with search cost—$\lambda'(c) > 0$ and $\lambda''(c) < 0$. This assumption means the more money inputted into job search, the higher possibility to receive job offer, while the marginal effect is diminishing. The second assumption is that unemployed workers can decide how much financial resource to put into job search in order to maximize their value of unemployment. This assumption makes the search cost endogenously decided. Although the second assumption in this paper is the same with Ben-Horim and Zuckerman (1987), the first assumption of this paper is different with theirs. Ben-Horim and Zuckerman's model assumes that job distribution changes with search cost, while my model assumes that search cost has effect on job arrival rate and has no relationship with job offer distribution.

After the two assumptions are introduced, the problem of the transition becomes

$$\underset{c}{\text{Max}}\ V \qquad \text{s.t.}\ rV = b - c + \lambda \int_0^\infty \max[0, W(x) - V]\, dF(x) \qquad (5)$$

Equation 2 tells that $rV = rW(w^*) = w^*$, which implies that maximizing the value of unemployment is equivalent with maximizing the reservation wage. Hence the object function can be changed from equation 5 to the following equation,

$$\operatorname*{Max}_{c}\ w^{*} \quad \text{s.t.}\ (\lambda / r)\int_{w*}^{\infty}[x - w^{*}]dF(x) = c + w^{*} - b \qquad (6)$$

For convenience, hereafter $h(w^{*})$ denotes $\int_{w*}^{\infty}[x - w^{*}]dF(x)$. Lagrange function is constructed to solve this question,

$$\underset{c}{L} = w^{*} + \theta\{(\lambda / r)h(w^{*}) - c - w^{*} + b\} \qquad (7)$$

Use F.O.C. $\partial L / \partial c = 0, \partial L / \partial \theta = 0$, in addition $\partial w^{*} / \partial c = 0$, which is implied by the assumption that there is an optimal search cost to maximize reservation wage. Hence the following equations can be got

$$\begin{cases} \partial w^{*} / \partial c + \theta[(h(w^{*}) / r)\partial \lambda / \partial c + (\lambda / r)h'(w^{*})\partial w^{*} / \partial c - 1 - \partial w^{*} / \partial c] = 0 & \text{(A)} \\ (\lambda / r)h(w^{*}) - c - w^{*} + b = 0 & \text{(B)} \\ \partial w^{*} / \partial c = 0 & \text{(C)} \end{cases} \qquad (8)$$

The solution is

$$\begin{cases} \partial \lambda / \partial c(h(w^{*}) / r) = 1 & \text{(A)} \\ (\lambda / r)h(w^{*}) - c - w^{*} + b = 0 & \text{(B)} \end{cases} \qquad (9)$$

Equation 9 (B) implies that when the return of search is equal to cost of job search, the reservation wage is rational. Equation 9 (A) implies when the marginal life-time income return from search is equal to marginal search cost, the rational reservation wage is optimized. If the search cost is chosen to maximize the value of unemployment, it must fulfill both of the two conditions specified in equation 9. In addition, reservation wage is assumed to be a concave function of search cost in this paper. This makes the optimal search cost the unique solution of the maximization problem. However, it is very hard to determine whether equation 9 has solution or not. In appendix 1, an example is given to show the existence of the possible solution. This example verifies that it is possible for unemployed worker to choose search cost to maximize their value of unemployment.

Suppose each period $\$a$ is available for unemployed workers to support his job search. UI receivers receive periodic benefits, $\$u$, over a maximum of N periods. The search strategy utilized by an insured person is characterized by a search expenditure policy $C = (c_1, c_2, \ldots)$ to maximize the expected value of unemployment, where c_n measures the search cost in period n. The expected UD is determined by the search cost and reservation wage.

The financial resources available to support job search are determined by two parts: one is from asset; the other is from social benefits. Individual asset is property net of debt and it includes monetary asset, such as bank saving and cash, etc and non-monetary asset, such as house or car, etc. Although it is impossible that whole asset is available to be utilized to support job search, it is reasonable to assume that the more the asset, the more financial resources available to support job search. Hence $v(A)$ is used to denote the available resource to support job search, where A denotes individual asset and $\frac{dv}{dA} > 0$. In order to distinguish the UI receiver and Non-UI receiver, a is assumed to be the financial resource from asset. The following equation can be constructed,

$$a = \nu(A) \ . \qquad (10)$$

For unemployed workers without UI, the strategy can be determined by the following model,

$$\underset{c \le a}{\text{Max}}\, w^* \qquad \text{s.t.} \, (\lambda / r)\int_{w^*}^{\infty}[x - w^*]dF(x) = c + w^* - b \qquad (11)$$

Let c^* be the global optimal search cost, which satisfies equation 9. There are two cases need to consider: if $c^* \le a$, which means unemployed workers can afford the optimal search cost; if $c^* > a$, which means unemployed workers cannot afford optimal job search, since it is assumed that reservation wage is a concave function of search cost, the feasible optimal search cost will be a. Therefore the feasible optimal search input of unemployed worker is $\hat{c} = \min(c^*, a)$.

For unemployed workers with UI, the UI benefits can not only be used to support job search but also add unemployment income. Hence the strategy can be determined by the following strategy:

$$\underset{c \le a+u}{\text{Max}}\, w^* \qquad \text{s.t.} \, (\lambda / r)\int_{w^*}^{\infty}[x - w^*]dF(x) = c + w^* - (b + u) \qquad (12)$$

Suppose $c^{\#}$ is the global optimal search cost. The feasible optimal search cost is $\tilde{c} = \min(c^{\#}, a+u)$

Since UI benefits are only available for N period, after UI expiration the problem for UI receivers would be the same problem as Non-UI receivers. To examine the impact of UI on expected UD, the transition rate of UI receivers and Non-UI receivers during the UI period will be compared. UI benefits can affect UD through two channels—reservation wage and search cost.

As to its effect on reservation wage, if UI is taken as part of unemployment income, it will increase unemployment income. In addition, UI can be used to support job search, which would broaden the boundary of financial resources. These two effects make the value of unemployment, or reservation wage for UI receivers lager than for Non-UI receivers, that is $w_{UI} > w_{NUI}$. Fishe (1982) uses the data obtained from Continuous Wage and Benefit History (CWBH) and finds that reservation wage are increased by UI benefits.

As to UI's effect on financial resources used for job search, this effect is determined by the relationship between $c^{\#}$ and c^{*}. In the example of appendix 1, the UI benefits are taken as the addition of unemployment income and it is inferred that $c^{\#} < c^{*}$ from the example. However, this cannot ensure that $c^{\#} < c^{*}$ in all cases. Later the effect of UI on expected UD will be discussed in two cases.

Equation 4 defines transition rate, or hazard rate $\phi = \lambda[1 - F(w^*)]$, which means the probability of transition out of unemployment in each period. And the expected UD can be computed by the following equation,

$$E_{UD} = \sum_{\mathrm{i}=1}^{\infty} \mathrm{i} \times \mathrm{prob(T = i)} = \sum_{\mathrm{i}=1}^{\infty} \mathrm{i} \times \phi \times (1 - \phi)^{(\mathrm{i-1})} = \frac{1}{\phi}, \qquad (13)$$

In order to compare the expected UD between UI receiver and Non-UI receiver, let ϕ^* be the transition rate from unemployment to employment and E be the expected UD for the Non-UI receiver; let $\phi^\#$ be the transition rate during the UI benefits period and $\overline{E}$ be the expected UD for UI receiver. According to equation 13, the expected UD for Non-UI receiver is

$$E = \frac{1}{\phi^*} \qquad (14)$$

For UI receiver,

$$\begin{aligned}
\overline{E} &= \sum_{i=1}^{N} i\phi^\#(1-\phi^\#)^{i-1} + \sum_{i=N+1}^{\infty} i(1-\phi^\#)^N (1-\phi^*)^{i-N-1}\phi^* \qquad (15)\\
&= \frac{1}{\phi^\#} - \sum_{i=N+1}^{\infty} i\phi^\#(1-\phi^\#)^{i-1} + \sum_{i=N+1}^{\infty} i(1-\phi^\#)^N (1-\phi^*)^{i-N-1}\phi^*\\
&= \frac{1}{\phi^\#} + (1-\phi^\#)^N\Big[\sum_{j=1}^{\infty}(N+j)(1-\phi^*)^{j-1}\phi^* - \sum_{j=1}^{\infty}(N+j)(1-\phi^\#)^{j-1}\phi^\#\Big]\\
&= \frac{1}{\phi^\#} + (1-\phi^\#)^N\Big(\frac{1}{\phi^*} - \frac{1}{\phi^\#}\Big)
\end{aligned}$$

And the relationship between E and $\overline{E}$ can be compared using the following function,

$$\overline{E} - E = \frac{1}{\phi^{\#}} - \frac{1}{\phi^{*}} + (1-\phi^{\#})^{N}(\frac{1}{\phi^{*}} - \frac{1}{\phi^{\#}})$$
$$= (\frac{1}{\phi^{\#}} - \frac{1}{\phi^{*}})[1-(1-\phi^{\#})^{N}]$$

Obviously, the above function shows that the relationship between E and $\overline{E}$ is determined by the relationship between $\frac{1}{\phi^{*}}$ and $\frac{1}{\phi^{\#}}$.

The impact of UI on expected UD can be discussed with two cases.

Case 1: $c^{*} \geq c^{\#}$, which means that optimal search cost for Non-UI receivers is no less than that for UI receivers. For unemployed workers who can afford the optimal search cost, i.e. $c^{*} \leq a$, during the period of UI benefits, reservation wage of UI receiver is higher and search cost is lower than their Non-UI counterparts. According to $\phi = \lambda[1-F(w^{*})]$, it is clear $\phi^{*} > \phi^{\#}$. Therefore, $\frac{1}{\phi^{*}} < \frac{1}{\phi^{\#}}$ and $\overline{E} > E$. In this case, UI will length the expected UD. For unemployed workers who cannot afford the optimal search cost, i.e. $c^{*} > a$, the UI receivers will use the UI benefits to support job search, which makes job arrival rate higher than that of their counterpart. Although the reservation wage is still higher than that of Non-UI receivers, it is possible that the transition rate of UI receiver is larger than that of Non-UI receiver, i.e. $\phi^{*} < \phi^{\#}$. Therefore, $\frac{1}{\phi^{*}} > \frac{1}{\phi^{\#}}$ and $\overline{E} < E$. In addition, the assumption $\lambda'(c) > 0$ and $\lambda''(c) < 0$ increases such possibility. When search cost is low, the marginal effect of search cost is high, which makes the positive effect of UI on job arrival rate dominate.

In above case, UI reduces expected UD for unemployed workers who cannot afford the optimal search cost and increases the UD for those who can afford the search cost. Because $\nu'(A) > 0$, when individual asset is below certain amount, UI decreases UD; when individual asset is above that amount, UI increases UD. In the empirical regression, an interaction form of individual asset and UI benefits receipt dummy will be used to examine whether the impact of UI on transition turns from positive to negative at certain amount of individual asset.

Case 2: $c^* < c^\#$, which means that optimal search cost for Non-UI receiver is less than for UI receiver. For unemployed workers who can afford the optimal search cost, i.e. $c^* \le a$, the reservation wage of UI receivers is higher than that of Non-UI receivers. And the search cost of UI receivers is higher than that of Non-UI receivers. This makes the relationship of transition rate between UI and Non-UI receivers ambiguous. For unemployed workers who cannot afford the optimal search cost, i.e. $c^* > a$, the analysis is the same with unemployed workers who cannot afford the optimal search cost in case 1, and it is possible that the transition rate of UI receiver is larger than that of Non-UI receiver, that is $\phi^* < \phi^\#$ and $\overline{E} < E$. In this case, UI reduces expected UD for unemployed workers who cannot afford the optimal search cost, and the effect of UI on UD is unclear for those who can afford the search cost.

In above two cases, case 1 infers that the effect of UI on UD turns from positive to negative with the increase of asset; in case 2, the change of the effect of UI on UD is unclear. It is possible that the impact of UI changes once as case 1, however the effect of

UI on UD may have other patterns. In order to check whether the inference that the effect of UI changes once with individual asset is preferred, an interaction form of cubic individual asset and UI benefits reception dummy will be used to display the possibility that the effect of UI on UD changes three times with individual asset. The empirical result will be used to testify which inference is superior.

It is assumed that the value of leisure is positively correlated with asset. The intuition is that for unemployed workers with more assets, they can spend more money enjoying their leisure happier and this gives them higher value of leisure. As a result, the reservation wage will increase with asset, which has been proven by Bloemen and Stancanelli (2001). They empirically test the impact of asset on reservation wage and verify that asset has a significant and positive impact on the reservation wage. At the same time, the individual asset can provide financial support for job search and raise the job arrival rate. Hence the impact of asset is ambiguous. However, according to $\lambda'(c) > 0$ and $\lambda''(c) < 0$, it is quite possible that when individual asset is low, the transition rate from unemployment to employment increases with individual asset and when individual asset is high, the transition rate decreases with individual asset. In empirical regression, quadratic form of individual asset will be used to examine the effect of individual asset.

CHAPTER 3

ECONOMETRIC MODEL

The job search model provides researchers with a powerful tool to analyze the problem of transition. So many empirical methods are used to check theoretical result. In this paper survival analysis is used to investigate the transition from unemployment to employment.

3.1 Hazard Rate Function

Hazard rate is the probability that a person who has been in unemployment for t time leaves it in the short interval of length dt after t, that is $P(T = t + dt \mid T \geq t)$. Dividing this probability by dt to get the average probability of leaving per unit time, the hazard rate is defined as

$$\phi(x,t) = \lim_{dt \to 0} \frac{P(T = t + dt \mid T \geq t)}{dt}.$$

where the relevant circumstances and personal characteristics of unemployed worker who has been looking for a job for t weeks are assembled in a vector $x(t)$. The elements of this vector include the level of UI benefits, the asset of the individual, and unemployment rate, etc. For a person described at t by $x(t)$, suppose his optimal amount of search produces a job arrival rate, $\lambda(x(t))dt$ and there is a probability $Q(x(t))$ that if such an offer is accepted. Then the outcome of this model-building effort is a quantity $\lambda(x(t))Q(x(t))dt = \phi(x(t))dt$, the probability of a transition out of unemployment. And $\phi(x(t))$ is the hazard function of transition from unemployment to employment and will be used to construct the model to test the derived theoretic result. The hazard rate means the probability of transition—even if all relevant $x(t)$ were known to the investigator he/she still will not be sure whether a transition will occur. Two estimation methods are used in this paper, i.e. parametric and semi-parametric estimation, to check whether the result is sensitive to the different estimation method.

3.2 Parametric Estimation

MLE method is used to estimate the impact of $x(t)$ on transition. $k(t)dt$ is the possibility of leaving unemployment at time interval ($t, t+dt$), where $k(t)$ is possibility density function (PDF) of transition from unemployment to employment; cumulated density function (CDF) $K(t)$ is the probability of staying unemployment for less than t period time; survivor function $\overline{K}(t)$ is the probability of remaining unemployed after t period time, and $\overline{K}(t) = P(T \geq t) = 1 - K(t)$.

$$\phi(t,\beta) = \lim_{dt \to 0} \frac{P(T = t + dt \mid T \geq t)}{dt} = \lim_{dt \to 0} \frac{P(T = t + dt)}{P(T \geq t)dt} = \lim_{dt \to 0} \frac{k(t)dt}{\overline{K}(t)dt} = \frac{k(t)}{\overline{K}(t)}$$

Solving the differential equation, $\overline{K}(t,\beta) = \exp(-\int_0^t \phi(t,\beta)dt)$, the PDF is

$$k(t,\beta) = \phi(t,\beta) * \exp(-\int_0^t \phi(t,\beta)dt) \quad (16)$$

Equation 16 denotes the transition PDF for individual at time *t*, β is the coefficient of $x(t)$. If a sample of *n* completed spell is available and each individual's spell is independent of others, the log-likelihood function of transition for the whole sample is

$$\Psi(t,\beta) = \sum_{i=1}^{n} \ln k(t_i,\beta), \quad (17)$$

where $\Psi(t,\beta)$ is the joint probability distribution of the sample as a function of β. When a spell is censored at duration t_j, the information known is only that the duration lasts at least to time t_j. Consequently, the contribution to the likelihood is the value of the survivor function, $\overline{K}(t_j,\beta)$, the probability that the duration is longer than t_j. Let $d_k = 1$ if the k^{th} spell is uncensored, and $d_k = 0$ if censored. The log-likelihood function is

$$\Psi(t,\beta) = \sum_{i=1}^{n} d_i \ln k(t_i,\beta) + \sum_{i=1}^{n} (1-d_i) \ln \overline{K}(t_i,\beta) \quad (18)$$

As $\overline{K}(t,\beta) = \exp(-\int_0^t \phi(t,\beta)dt)$ and $k(t,\beta) = \phi(t,\beta) * \exp(-\int_0^t \phi(t,\beta)dt)$, after substituting them into equation 18, the log-likelihood function can be written in terms of the hazard function

$$\Psi(t,\beta) = \sum_{i=1}^{n} d_i \ln \phi(t_i,\beta) - \sum_{i=1}^{n} \int_0^{t_i} \phi(t_i,\beta)dt \qquad (19)$$

Equation 19 is the target function to be used to estimate β , the coefficient vector of $x(t)$.

In order to estimate the coefficients of $x(t)$, the function form of hazard must be specified. The proportional hazard function of $\chi(t)e^{\beta x}$ is often used by previous studies, which says that the coefficients of x do not change over time. $\chi(t)$ is known as baseline hazard function. In parametric estimation, the function form of hazard rate must be fully specified. The simplest distribution is exponential distribution. In this case, the hazard rate is constant $e^{\beta x}$, which means that the possibility of reemployment remains the same over time. The constant hazard function can be extended to be time-varying, $\phi(t) = \alpha t^{\alpha -1} e^{\beta x}$ which allows the possibility of reemployment to vary with time. This kind of distribution of hazard is known as Weibull distribution. Exponential distribution is a special case of Weibull distribution when $\alpha=1$. Another form of proportional hazard function is called Gompertz distribution. The baseline hazard is $\chi(t) = \exp(\gamma t)\exp(\beta_0)$, and the baseline hazard varies exponentially with time, hence hazard function is $\phi(t) = \exp(\gamma t)\exp(\beta_0 + \beta x)$.

Layte and Callan (2001) use Akaike Information Criterion (AIC) to choose the hazard rate among Complementary Log-log, Weibull and Precise Constant distribution. In this paper, I follow their method to choose the proper hazard rate function with AIC. For parametric survival models, the AIC is defined as

$$AIC = -2\ln L + 2(k+c) \qquad (20)$$

where $\ln L$ is log-likelihood value, k is the number of model covariates and c the number of model-specific distributional parameters. The preferred model is the one with the lowest AIC value. Results reported in table 1 show that Weibull distribution has the lowest AIC value; therefore in this paper I select the Weibull distribution as hazard rate function.

Table 1: Comparison of AIC Value for Three Models

Distribution	Log Likelihood	k	c	AIC
Exponential	−1479.2538	17	1	2994.508
Weibull	−1466.8809	17	2	2971.762
Gompertz	−1478.7111	17	2	2995.422

Heterogeneity is also an important question to be dealt with. Kiefer (1984) [P.539] says "Heterogeneity can arise from left-out regressors, functional from misspecification, or unobservable variation in taste. Unless the heterogeneity components are independent of repressors, inferences ignoring heterogeneity can be seriously biased". The most frequent way of dealing with heterogeneity is to use the mixing distribution, that is, the density function, $k(\beta,t)$ changes to $k(\beta,t\,|\,\varepsilon)$, where ε is heterogeneity component and the distribution of ε is $p(\varepsilon)$. The correct density function for contribution to likelihood function is $k(t,\beta)=\int k(t,\beta\mid\varepsilon)p(\varepsilon)d\varepsilon$. In this paper the commonly used Inverse-Gaussian distribution is used to control for the distribution of heterogeneity.

3.3 Semi-parametric Estimation

The semi-parametric approach suggested by Cox (1972) can be used to estimate β in the proportional hazard model without specifying the form of the baseline hazard function $\chi(t)$. Suppose the completed durations are ordered $t_1 < t_2 < ... < t_n$. For the present suppose there is no censoring and there are no ties in the duration. The conditional probability that observation 1 concludes a spell at duration t_1, given that any of the n observations could have been concluded at duration t_1, is $\dfrac{\phi(t_1,x_1,\beta)}{\sum_{i=1}^{n}\phi(t_i,x_i,\beta)}$. With the proportional hazard assumption $\phi(t,x\beta)=\Phi(x,\beta)\chi(t)$, this expression reduces to $\dfrac{\Phi(x_1,\beta)}{\sum_{i=1}^{n}\Phi(x_i,\beta)}$, which is the contribution of the shortest duration to the partial likelihood.

Similarly, the contribution of j^{th} shortest duration is $\dfrac{\Phi(x_j,\beta)}{\sum_{i=j}^{n}\Phi(x_i,\beta)}$. The likelihood is formed as the product of the individual contribution, and the resulting log-likelihood function is

$$\Psi(\beta)=\sum_{i=1}^{n}\left\{\ln\Phi(x_i,\beta)-\ln\left[\sum_{j=i}^{n}\Phi(x_j,\beta)\right]\right\} \qquad (21)$$

The intuition here is that, in the absence of all information about the baseline hazard, only the order of the durations provides information about the unknown coefficients. Censoring is handled in partial likelihood estimation this way: an individual censored between duration t_j and t_{j+1} appears in the denominator of log-likelihood of observations 1 through j, not in any others. Censored spells do not enter the numerator. Ties can be handled by using the same denominator.

Equation 21 is more flexible than equation 19, because it does not specify the form of $\chi(t)$ subjectively. Meyer (1990) uses semi-parameter estimation to investigate the impact of UI on UD and concludes the advantage of semi-parametric method compared with full-parametric estimation is that semi-parametric estimation avoids inconsistently estimating covariate coefficients due to misspecified baseline hazard. In order to see whether the result is sensitive to the estimation method, both the Weibull distribution and the semi-parameter method will be used in the regression.

CHAPTER 4

DATA

The data used in this paper is the U.S. National Longitudinal Survey of Youth 79 (NLSY79). NLSY79 records information of the respondents over 20 years. The interviewers will periodically ask the same person about his/her work history and personal characteristics during the past year.

4.1 Introduction to NLSY79

NLSY79 is administrated by US Department of Labor. NLSY79 has collected data on each respondent's labor force experience, labor market attachment, and investment in education and training through 1978 to 2000. In addition, these data contain comprehensive information of UI benefits receivers. The NLSY79 is conducted annually from 1979 to 1994, biennially after 1994 and consists of three sub samples: (1) A cross-sectional sample of 6,111 respondents designed to be representative of the non-institutionalized civilian segment of young people in the United States; (2) A supplemental sample of 5,295 respondents designed to oversample civilian Hispanic, black, and economically disadvantaged living in the United States; (3) A sample of 1,280 respondents designed to represent the population who are enlisted in army.

NLSY79 have been extensively used by many researchers. Cameron, Gritz and Macurdy (1989) use NLSY79 to explore the impact of UI on UD and find an individual who collects UI compared to one who does not is likely to experience a longer UD. Budd and Mccall (1997) use NLSY79 to see the impact of unions on the receipt of UI benefits and find that unions have no significant effect on UI take-up among white-collar workers; but blue-collar union workers eligible for UI benefits are 23% more likely to be UI receivers than are their nonunion counterparts.

4.2 Data Processing

From NLSY79, two kinds of individuals are chosen: unemployed workers without UI and unemployed workers with UI, both of whom find job after unemployment. Since only year 1990, 1992, 1993, 1994, 1996, 1998 and 2000 survey contain information on asset net of debt for the individual, the data in these years are used in regression. The following criteria are used to select sample.

(1) Only the cross-section sample is used to avoid sample bias, which includes 6111 individuals;

(2) To minimize the bias that rises from recalling mistakes, individual should attend 2 consecutive interviews;

(3) Individual must be at least 18 years old when being interviewed;

(4) The individual has work experience when he or she attends the interview;

(5) The individual has not been in regular school since last interview;

(6) There is no missing value of the variables used in the regression.

By requirements (2)–(6), 4978 individuals are collected. Since this paper only examines the transition from unemployment to employment, the individuals are deleted from the sample if they transit from unemployment to out of labor force. In addition, individuals whose UI claim period does not agree with reported unemployment spell is deleted from the sample. My final sample consists of totally 1054 individuals—289 UI receivers and 765 Non-UI receivers. In the sample, many individuals have multiple unemployment spells. For the selected individuals with more than one unemployment spell, the unemployment spells are combined into one spell if the time between spells is no more than 2 weeks because it is too short to be deemed as a successful transition from unemployment to employment. Furthermore, for each individual only one unemployment spell is used to avoid duration correlation.

4.3 Control Variables

In this paper personal characteristics and labor market circumstances are controlled for. The control variables include gender, race, education, work experience, marital status, having children or not, local unemployment rate, resident region, individual asset and whether individual receives UI.

Dummy variable, male=1 if the respondent is a male and zero otherwise. White=1 if the respondent is a white and zero otherwise; black=1 if the respondent is a black and zero otherwise, leaving other race as reference group. To control for the past work history, work experience[3] and number of weeks in unemployment in past year are used. The highest grade certificate (HGC) is used to control for education level. Furthermore Armed Forces Qualifications Test (AFQT)[4] score is used to control for the ability of individual. A dummy variable married=1 if the respondent is married and zero otherwise. Whether the individual has children or not is also controlled for in regression. In addition, the interaction form of male and children is added to capture the potential impact of children on transition of male. To control for the labor demand situation, local unemployment rate and the region of residence of the respondent are used. Asset is divided by consumer price index (CPI 1990=100) to standardize different year's asset and is transformed into logarithm form. Dummy RECVUI is used to show whether unemployed workers received UI; RECVUI=1, if unemployed worker receives UI, otherwise RECVUI=0. To test the theoretical result that UI possibly can increase the transition rate for unemployed workers with little asset, the interaction term between RECVUI and individual asset is also included in the regression. In addition, in order to test whether the effect of asset on UD actually acts as theoretically expected, the quadratic form of asset is used in regression. Table 2 summarizes the variables of entire sample, UI receivers and Non-UI receivers.

[3] The work experience is computed as $exp=Age-Edu-6$.

[4] The creation of AFQT involves (1) computing a verbal composite score by summing word knowledge and paragraph comprehension raw scores; (2) converting subtest raw scores for verbal, math knowledge, and arithmetic reasoning; (3) multiplying the verbal standard score by two; (4) summing the standard scores for verbal, math knowledge, and arithmetic reasoning; and (5) converting the summed standard score to a percentile.

Table 2: Summary Statistics of Variables

Variable	Whole Sample				UI receiver		Non-UI receiver	
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Mean	Std. Dev.
RECVUI (receive UI=1, otherwise=0)	0.27	0.45	0	1	-	-	-	-
Asset	9.09	1.82	-0.18	14.30	9.42	1.71	8.96	1.84
White (white=1, non-white=0)	0.81	0.39	0	1	0.87	0.33	0.79	0.41
Black (Black=1, non-black=0)	0.15	0.36	0	1	0.09	0.29	0.18	0.38
Married (married=1, not married=0)	0.52	0.50	0	1	0.59	0.49	0.50	0.50
Male (male=1, female=0)	0.53	0.50	0	1	0.55	0.50	0.52	0.50
Have Children or not (Have children=1, does not have children=0)	0.55	0.50	0	1	0.57	0.50	0.55	0.50
Male × Number of Children	0.49	1.00	0	7	0.55	1.02	0.46	0.99
Experience	14.00	4.38	2	28	13.90	4.03	14.03	4.51
Weeks unemployed in the past year	9.14	12.40	0	52	10.94	11.49	8.46	12.67
Highest Grade Certificate	12.90	2.24	0	20	13.04	2.10	12.84	2.29
AFQT	42.54	26.87	1	99	46.96	26.35	40.87	26.89
South (live in the south=1, otherwise=0)	0.37	0.48	0	1	0.33	0.47	0.38	0.49
Local unemployment rate	6.52	2.85	1.5	16.5	7.01	2.93	6.34	2.80
Observation	1054				289		765	

4.4 Descriptive Duration Analysis

Figure 1 shows Kaplan-Meier hazard[5] rate for the whole sample. The transition rate does not show any obvious pattern over time.

Figure 1: Hazard Rate of the Whole Sample

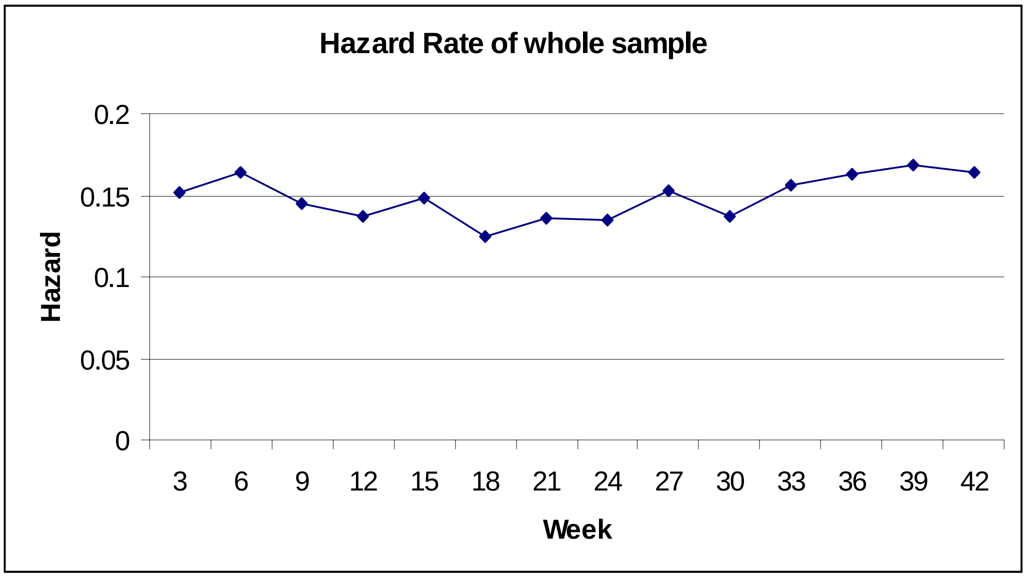
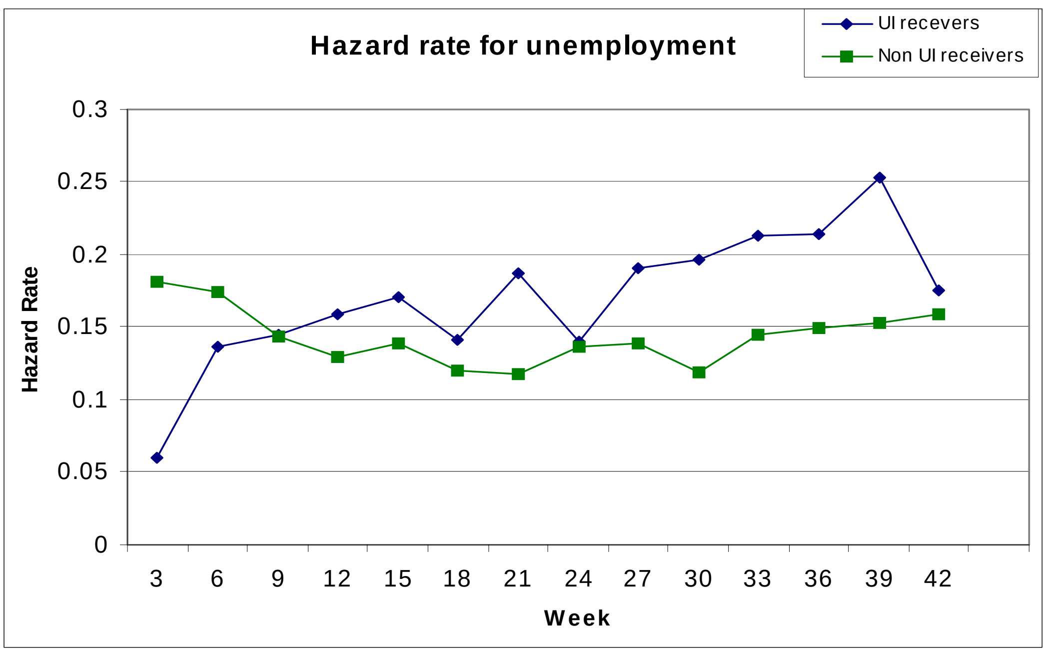


Figure 2 plots the hazard for both the UI receivers and Non-UI receivers. It is interesting to note that hazard rate of these two groups shows different pattern. For unemployed workers without UI, hazard rate is high at the beginning of unemployment spell and then decreases to be flat; for unemployed workers with UI, the hazard rate is low initially and increases with unemployment duration. This tells that the Non-UI receivers try to find a job as soon as possible, while the UI receivers prefer to search longer for better jobs or just enjoy the leisure at the beginning of unemployment spell. Figure 2 shows that after

[5] The method of computing Kaplan-Meier hazard rate is in appendix 2.

about 10 weeks, hazard rate of UI receivers becomes larger than that of Non-UI counterpart; the possible reason is that Non UI receivers with high competencies in job market have found a job during 10 weeks after they get unemployed, leaving unemployed workers for whom it is difficult to find a job. In addition, for the UI receivers, the transition rate increases a lot around the 26th week and after that time the hazard rate increases all the time until the week 39. This result may be due to the regulation that UI benefits expire at the end of 26th week[6]. The detail of the U.S. regulation of UI is referred to appendix 3.

Figure 2: Hazard Rate of Unemployed Workers with UI and without UI



[6] According to U.S. regulation, if the unemployment rate is very high there will be another 13 weeks extended UI.

CHAPTER 5

RESULT AND EXPLANATIONS

The hazard rate takes the form of $\phi(t,x,\beta)=\chi(t)e^{x\beta}$ and the ratio of hazard for a change from $x_i=a$ to $x_i=b$ is $Ratio=\dfrac{\phi(t,x_i=b,x,\beta_i,\beta)}{\phi(t,x_i=a,x,\beta_i,\beta)}=\dfrac{\chi(t)e^{b\beta_i+x\beta}}{\chi(t)e^{a\beta_i+x\beta}}=e^{(b-a)\beta_i}$. where e^{β_i} shows the increase in hazard rate to the original if the covariate increases by one unite. If $\beta_i>0$, the probability of transiting out of unemployment increases with the value of x_i , vice versa. Table 3 reports the result.

Table 3: Regression Result of Whole Sample

Independent Variable	Coefficient			
	Equation (1)	Equation (2)	Equation (3)	Equation (4)
Effect of UI on transition				
RECVUI	0.776** (0.372)	0.832** (0.369)	1.153** (0.585)	-13.046* (7.497)
RECVUI X Asset	-0.110*** (0.039)	-0.118*** (0.039)	-0.169*** (0.062)	4.629* (2.648)
RECVUI X Asset^2	-	-	-	-0.519* (0.304)
RECVUI X Asset^3	-	-	-	0.018* (0.011)
Effect of Asset on Transition				
Asset	0.344*** (0.113)	0.392*** (0.114)	0.551*** (0.169)	0.449** (0.176)
Asset ×Asset	-0.020*** (0.006)	--0.023*** (0.007)	-0.032*** (0.010)	-0.026** (0.010)
Personal characters				
White	0.017 (0.169)	0.049 (0.169)	0.104 (0.259)	0.098 (0.259)
Black	0.063 (0.183)	0.116 (0.183)	0.162 (0.283)	0.147 (0.283)
Married	0.094 (0.076)	0.097 (0.076)	0.150 (0.117)	0.161 (0.117)
Male	0.220*** (0.084)	0.247*** (0.084)	0.330** (0.131)	0.339*** (0.131)
Have Children or not	0.084 (0.089)	-0.021 (0.089)	-0.066 (0.138)	-0.067 (0.138)
Male ×Number of Children	0.045 (0.045)	0.054 (0.045)	0.078 (0.070)	0.079 (0.070)
Work history				
Experience	0.011 (0.036)	0.017 (0.036)	0.010 (0.056)	0.011 (0.057)
Experience ×Experience	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.002)	-0.001 (0.002)
Weeks of Unemployment in past year	-0.032*** (0.003)	-0.036*** (0.003)	-0.062*** (0.004)	-0.063*** (0.005)

Education and skills				
Highest Grade Certificate	0.007 (0.02)	0.008 (0.020)	0.008 (0.031)	0.007 (0.031)
AFQT	0.003* (0.002)	0.004* (0.002)	0.004* (0.002)	0.004* (0.002)
Labor market factors				
Live in the south	-0.065 (0.067)	-0.087 (0.067)	-0.139 (0.104)	-0.145 (0.104)
Local unemployment Rate	-0.032*** (0.012)	-0.036*** (0.012)	-0.050*** (0.018)	-0.052*** (0.018)
Hazard function form	Semi-parameter	Weibull distribution	Weibull distribution	Weibull distribution
Control Heterogeneity	No	No	Yes	Yes
Number of observation	1054	1054	1054	1054
LR Test	246.09	314.13	326.32	331.18
Pro>Chi^2	0.000	0.000	0.000	0.000
Log likelihood	-6195.108	-1466.384	-1405.102	-1402.669

Note: *** represents the significant level at 1%
** represents the significant level at 5%
* represents the significant level at 10%

Equation 1 uses the semi-parametric model, and equation 2 uses the Weibull distribution. Although equation 1 and equation 2 use different regression method, the coefficients and standard error are very similar between these two equations, which means that the result is insensitive to whether the semi-parametric or the Weibull distribution is used. Furthermore, equation 3 uses Weibull distribution and inverse-Gaussian heterogeneity distribution. A comparison between the results of equation 3, equation 1 and equation 2 shows that:

(1) The sign of the coefficients are the same for all three estimation methods; (2) The standard errors estimated using equation 3 are slightly larger than those of equation 1 and equation 2. This is probably because that equation 3 controls for the heterogeneity;

(3) The coefficient is a bit larger than that of equation 1 and equation 2, the possible reason is that after the heterogeneity is controlled for, the downward bias caused by the correlation between covariate and error term is reduced;

(4) The significant level of the covariates almost does not change, except that the significant level of Male changes from 0.01 to 0.05;

(5) The log likelihood value increases a lot compared with equation 2.

Based on the result of equation 1, 2, 3, even if the heterogeneity is control for, the result almost does not change. Since within equation 2 and 3, the log likelihood value of equation 3 is much lager than that of equation 2, which means controlling for the heterogeneity improves the regression, the model which uses Weibull distribution as hazard rate function and inverse-Gaussian distribution to control for the heterogeneity is used to report regression result.

5.1 Impact of UI on UD

The theoretical model of this paper has illustrated two possibilities to show the impact of UI on expected UD. In order to test which inference is preferred, one critical value of asset is compared with three critical values through empirical result. Equation 3 reports the result of one critical value of asset and equation 4 reports the three critical values of asset. The log-likelihood rate of equation 4 only improves 2.5 points compared with that of equation 3. The reason is that equation 4 has two more variables than equation 3. The minor increase of log-likelihood rate tells that adding two more variables almost does not improve the result. In equation 4, the new added variables, RECVUI×Asset^2, and RECVUI×Asset^3 are significant only at 10% level. In addition, after these two variables are added into the regression, the variables, RECVUI and RECVUI×Asset, become less significant. All above comparisons show that adding the two variables RECVUI×Asset^2, and RECVUI×Asset^3, cannot improve the result. Therefore these two variables should not be included in regression model. Based on above analysis, the empirical result prefers one critical value of asset to three critical value of asset. Hereafter equation 3 is used to report the empirical result.

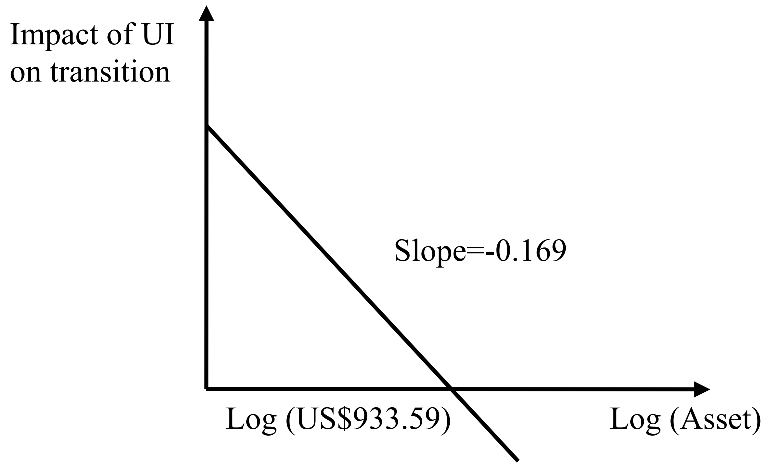
The turning point where the impact of UI on transition rate turns from positive to negative is computed. When log asset is larger than (1.153/0.169), that is 6.839, the impact of UI on transition rate becomes negative. Therefore when individual asset is over $e^{6.839}$, US$933.59 based on 1990 dollar, UI would induce longer expected UD. It is helpful to see the proportion of unemployed workers whose assets are below this critical value. The distribution of individual asset is reported in table 4 and US$933.59 accounts for about 12.4% individuals of the sample.

Table 4: Distribution of Individual Asset

Percentiles	5%	10%	**12.3%**	25%
Asset	465.57	904.43	**931.15**	2500
Percentiles	50%	75%	90%	95%
Asset	9044.31	33319.73	81216.84	152291.3
Mean		35787.74		
Standard Deviation		95994.95		

Because UI has incentive effect on job search for a small proportion of the population, if the whole sample is used and interaction form of UI and personal information is not included, it is very hard to find that impact of UI changes with personal characteristics and it is easy to conclude that UI has negative effect on reemployment. This explains why most previous studies find that UI has negative impact of on transition from unemployment to employment. Therefore in order to understand the nature of UI, it is improper to use only UI variables, since for different people the impact of UI may be different. In addition, besides the effect of UI on the possibility of accepting a wage, the impact of UI on job arrival rate should be taken into consideration as well. The empirical result supports the result derived from theoretical part and provides a direct example that UI can provide financial assistance to help job search.

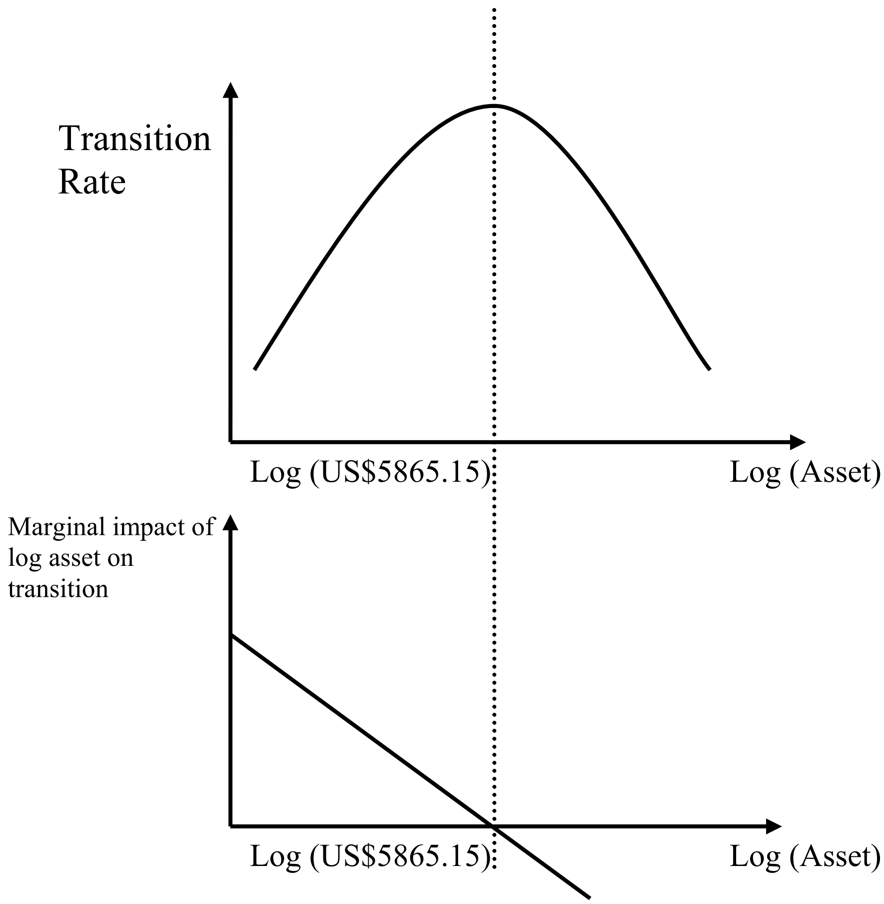
Figure 3: The Impact of UI on UD with Variation of Individual Asset



5.2 Impact of Individual Asset on UD

The empirical result agrees with the inference that it is possible that when asset is low, the positive effect of asset on transition dominates; when asset is high, the negative effect dominates. The coefficients on the quadratic of asset are significant at the 1% level. From regression result $a = -0.032$ and $b = 0.551$, it means that if asset increase one log point, the transition will increase $2 \times (-0.032) Asset + 0.551$. This clearly confirms that when asset is below a certain amount, the positive impact of asset on transition dominates and transition rate increases with asset; when asset is over a certain amount, the negative impact of asset on transition dominates and transition rate decreases with asset. It is easy to compute the value of critical point, $\overline{Asset} = -b/2a$, that is 8.677. Transforming the logarithm value into normal value, it is US$5865.15 1990 dollars. Figure 4 shows the effect of assets on transition rate.

Figure 4: The Impact of Asset on Transition Rate



This figure gives a rough picture of impact of asset on transition and confirms the theoretical inference. The results above are a little different from some previous papers. Previous researchers often ignore the impact of asset on job arrival rate; some of them treat it to be determined exogenously and just set it as constant. Danforth (1979) proves that a worker's reservation wage increases with his asset, but the author does not explore the possibility that an individual's asset may affect his job arrival rate. As a result, he infers that the transition rate will decrease with asset monotonically. This paper assumes the job arrival rate is positively correlated with search expenditure and finds transition rate increases with individual asset for unemployed workers with limited asset and decrease with individual asset for the unemployed worker whose asset is above certain amount.

5.3 Impact of Other Variables on UD

Besides RECVUI and individual asset, personal characteristics, work history, education level and skill, and labor market factors also affect UD. The whites transit out of unemployment a little faster than the reference group. An interesting finding is that the expected UD of the black is a little shorter than that of the white although this effect is insignificant. This may be due to the fact that the blacks are more willing to accept job offer if given, while the whites prefer to search a little longer to get better jobs. Married individuals leave unemployment a little faster than unmarried. This may be due to their heavy family burden compared with the singles and hence they search more intensively. The expected UD for males is shorter than for females and this effect is significant at the 5% level. One possible reason is that because males are usually the bread earner of the family, they are more eager to transit out of unemployment to earn money to support their families. Unemployed females with children spend more time in unemployment; this may be contributed to that the unemployed females with children are willing to spend more time caring for their children. However unemployed males with children find job faster, because they have to feed the family and children, the heavy family burden forces them to find jobs quickly.

As to the work history, the transition rate increases with work experience first, then decreases with work experience. The turning point is seven years. This may be because that after seven years, the human capital accumulation will be a little outdated, which makes it harder for these unemployed workers to find a job. Another factor which may influence the transition rate is erosion of the skill. It is known that if people do not work for a long time, his or her working skill will be eroded. This might be one reason to explain why weeks of unemployment in past year, is significant and negative. Another possible reason might be their unobserved characteristics, that is, certain unemployed workers stay in unemployment longer than others.

In the education and skill part, AFQT is significant and positive, which means that the higher AFQT score, the shorter the expected UD. Because AFQT shows the ability of individual, it is reasonable to assume the AFQT and job offers is positively correlated and this makes unemployed workers with high AFQT score easier to find a job. Similarly, if highest grade certificate of unemployed workers is higher, he or she is easier to find job, although highest grade certificate is insignificant.

As to labor market factors, region of residence and local unemployment rate are used to control for the labor market factors. The region of residence takes negative sign; the possible reason is that the labor demand in the south of U.S. is less than in other places. And the local unemployment rate has negative and significant impact on transition. When the unemployment rate is high, the competition of finding a job is strong and the labor demand is reduced. Consequently it would make unemployed workers stay in unemployment longer.

CHAPTER 6

IMPLICATION AND APPLICATION

The main points of this paper are (1) the impact of UI on expected UD is affected by individual asset—when individual asset is below a certain amount, UI can possibly reduce the expected UD; when an individual's asset is above a certain amount, UI will increase the expected UD; (2) individual asset does not monotonically increase the expected UD, it can provide money to help unemployed workers to search job, which causes that when asset is low, the transition rate increases with asset. In this paper, this result is derived from theory and checked from empirical regression.

It has been shown that the transition rate is determined by job arrival rate and the possibility of accepting job offer. Many researchers only pay attention to the possibility of accepting job offer, ignoring the potential effect of job arrival rate on transition rate, which will bias the incentive effect of UI and individual asset. In addition, in order to find how UI takes effect, it is better not to just use UI variable, such as level of UI benefits and UI benefits duration, but to consider the channel through which UI influences UD. More researches are needed to consider the channel to understand how UI works.

As to the policy applications, Lancaster and Nickell (1980) say that in order to reduce the unemployment rate, the government must cut down the benefits level. This may be a method to reduce the unemployment rate. However, it is known that the purposes of UI include (1) maintaining the consumption level of people in case of unemployment; (2)

helping unemployed workers find a job. If the benefits level is cut down for all UI receivers, for those unemployed with limited resources, the consumption level will be reduced, which will decrease their welfare a lot. It can be inferred that cutting down benefits level for all UI receivers may cause negative effect for unemployed workers with limited asset, because unemployed workers with low asset have to stay longer in unemployment if the benefits level is reduced.

This paper finds that with the increasing of asset, the disincentive effect of UI becomes larger. One application is to tax the high-income UI receivers. Before 1979, unemployment insurance was not treated as taxable income in the United States. Several economists criticize this policy on the ground that not taxing UI benefits while taxing earnings allegedly encourages unemployed persons to conduct longer than socially optimal job search. Since 1979 UI benefits received by persons in higher-income families have been subject to income tax. Solon (1985) investigates whether the introduction of benefits taxation has the predicted effect of reducing unemployment duration. His study uses data on a sample of persons that files for UI in 1978 or 1979 to examine whether high-income receivers collect benefits for shorter periods after the tax changes than they do before benefits becomes taxable. His paper presents persuasive evidence of tax effect on unemployment duration. The 1979 policy change is estimated to have reduced average unemployment duration among the sampled high-income receivers by about one week. However, there are not many measures taken for the UI receivers who are poor. It is suggested that the government give other kinds of subsidy to unemployed workers to help them find job.

CHAPTER 7

CONCLUSION

This paper extends Mortensen's model by relaxing two assumptions: one is that job arrival rate is positively correlated with search cost; the other is that the search cost is endogenously determined by unemployed workers to maximize value of unemployment. As a result, the model shows that unemployed workers will choose an optimal search cost according to their financial constraint.

I find that for unemployed workers whose available financial resources are below the optimal search cost, UI benefits can support their job search and hence reduce the expected UD. However, for unemployed workers who can afford the optimal search cost, the impact of UI benefits is ambiguous. I also find it is possible that when individual asset is below certain amount, transition rate increases with asset and when individual asset is above this amount, transition rate decreases with asset.

I use the data extracted from U.S. NLSY79. After the personal characteristics and labor market situations are controlled for, the empirical model tests two alternative cases of the impact of UI on expected UD, i.e. one critical value and three critical values of asset. The empirical result prefer one critical value of asset and finds that UI reduces the expected UD if individual asset is below US$933.59 based on 1990's dollars, which accounts for 12.4% individuals of the sample, and increases the expected UD if individual asset is above that amount. Furthermore it is also found that when individual asset is below

US$5865.15 based on 1990's dollars, the transition rate increases with asset; when individual asset is above this amount, the transition rate decreases with asset.

The empirical model uses the semi-parametric and parametric survival analysis and empirical results are stable across different estimation method even if the heterogeneity is controlled for, which implies that the empirical result is robust.

BIBLIOGRAPHY

Anthony, Atkinson B., and Micklewright, John. “Unemployment Compensation and Labor Market Transitions: A Critical Review.” *Journal of Economic literature* 29 (1991): 1679-1727.

Barron, John M., and Mellow, Wesley. “Search Effort in the Labor Market.” *Journal of Human Resources* 14 (1979): 389-404.

Ben-Horim, Moshe, and Zuckerman, Dror. “The Effect of Unemployment Insurance on Unemployment Duration.” *Journal of Labor Economics* 5 (1987): 386-390.

Bloemen, Hans G., and Stancanelli, Elena G. F. “Individual Wealth, Reservation Wages, and Transitions into Employment.” *Journal of Labor Economics* 19 (2001): 400-439.

Cameron, Colin A.; Gritz, Mark R.; and MaCurdy, Thomas. “The Effect of Unemployment Compensation on the Unemployment of Youths.” *National Longitudinal Surveys discussion paper* (1989).

Fallick, Chelimsky Bruce. “Unemployment Insurance and the Rate of Re-employment of Displaced Workers.” *Review of Economics and Statistics* 73 (1991): 228-235.

Cox, David R. “Regression Models and Life-Tables (with discussion).” *Journal of the Royal Statistical Society* 34 (1972): 187-220.

Danforth, John P. “On the Role of Consumption and Decreasing Absolute Risk Aversion in the Theory of Job Search.” In *Studies in the Economics of Search*, edited by S. A. Lippman and J. J. McCall, pp. 109-131. Amsterdam: North-Holland, 1979.

Danziger, Sheldon; Haveman, Robert; and Plotnick, Robert. “How Income Transfer Programs Affect Work, Savings, and the Income Distribution: A Critical Review.” *Journal of Economic Literature* 19 (1981): 975-1028.

Fishe, Raymond P. H. “Unemployment Insurance and the Reservation Wage of the Unemployed.” *Review of Economics and Statistics* 64 (1982): 12-17.

Green, David A., and Riddell, Craig W. “Qualifying for Unemployment Insurance: An Empirical Analysis.” *Economic Journal* 107 (1997): 67-84.

Ham, John C., and Rea, Samuel A. “Unemployment Insurance and Male Unemployment Duration in Canada.” *Journal of Labor Economics* 5 (1987): 325-353.

Holzer, Harry J. “Search Method Used by Unemployed Youth.” *Journal of Labor Economics* 6 (1988): 1-20.

Hughes, James J.; Peoples, James; and Perlman, Richard. “The Differential Impact of Unemployment Insurance on Unemployment Duration by Income Level.” *International Journal of Manpower* 17 (1996): 18-33.

Jennifer, Hunt. “The Effect of Unemployment Compensation on Unemployment Duration in Germany.” *Journal of Labor Economics* 13 (1995): 88-120.

Kahn, Lawrence M., and Low, Stuart A. “Systematic and Random Search A Synthesis.” *Journal of Human Resources* 23 (1988): 1-20.

Kettunen, Juha. “Duration-dependent Features of Unemployment Insurance.” *Economics Letters* 51 (1996): 115-121.

Kiefer, Nicholas M. “A Simple Test for Heterogeneity in Exponential Models of Duration.” *Journal of Labor Economics* 2 (1984): 539-549.

Kiefer, Nicholas M. “Economic duration Data and Hazard Functions.” *Journal of Economic Literature* 26 (Jun 1988): 646-679.

Lancaster, Tony, and Nickell, Stepjen J. “The Analysis of Re-Employment Probabilities for the Unemployed.” *Journal of Royal Statistics Society* 143 (1980): 141-152.

Layte, Richard, and Callan, Tim. “Unemployment, Welfare Benefits and Financial Incentive to Work.” *Economic and Social Review* 32 (2001): 103-129.

Lippman, S. A., and MaCall, J. J. “The Economics of Job Search: A Survey.” *Economic Inquiry* 14 (1976): 155-189.

Maki, Dennis, and Spindler, Z. A. “The Effect of Unemployment Compensation on the Rate of Unemployment in Great Britain.” *Oxford Economics Papers* 27 (1975): 440-454.

Meyer, Bruce D. “Unemployment Insurance and Unemployment Spell.” *Econometrica* 58 (1990): 757-782.

Moffit, Robert. “Unemployment Insurance and the Distribution of Unemployment Spells.” *Journal of Econometrics* 28 (1985): 85-101.

Moffit, Robert. “Incentive Effect of the U.S. Welfare System: A Review.” *Journal of Economic Literature* 30 (1992): 1-61.

Mortensen, Dale T. “Job Search, the Duration of Unemployment and the Philips Curve.” *American Economic Review* 60 (1970): 847-862.

Mortensen, Dale T. “Unemployment Insurance and Job Search Decisions.” *Industrial and Labor Relations Review* 30 (1977): 505-517.

Mortensen, Dale T. “Job Search and Labor Market Analysis.” In *Handbook of Labor Economics*, Vol. 2, edited by Orley C. Ashenfelter and Richard Layard, pp.849-919. Amsterdam: North-Holland, 1986.

Peterson, Richard L. “Economics of Information and Job Search: Another View.” *Quarterly Journal of Economics* 86 (1972): 127-131.

Roed, Knut, and Zhang, Tao. “Does Unemployment Compensation Affect Unemployment Duration.” *Economic Journal* 113 (2003): 190-206.

Solon, Gary. “Work Incentive Effects of Taxing Unemployment Benefits.” *Econometrica* 53 (1985): 295-306.

Tannery, Frederick J. “Search Effort and Unemployment Insurance Reconsidered.” *Journal of Human Resources* 18 (1983): 432-440.

US Social Security Administration. “Social Security Programs in the United States.” *SSA publication*, 13-11758 (1997): 25-36.

Wadsworth, Jonathan. “Unemployment Benefits and Search Effect in the UK Labor Market.” *Economica* 58 (1991): 17-34.

Zuckerman, Dror. “Optimal Unemployment Insurance Policy.” *Operations Research* 33 (1985): 263-276.

APPENDIX 1

AN EXAMPLE TO SHOW THE EXISTENCE OF OPTIMAL SEARCH COST

A.1 The Solution of Optimal Search Cost

Equation 9 lists the conditions for the optimal search cost. Here an example is used to show that there possibly exists an optimal search cost. Suppose the job offer distribution is uniform distribution[7] in the interval (*0*, *A*) — the possibility density function (PDF) is

$$f(x) = \begin{cases} 1/A, \ x \in (0, A) \\ 0, \text{otherwise} \end{cases}.$$

In addition, assume that the job arrival rate $\lambda = 1 - e^{-c}, (c \geq 0)$, which agrees with that $0 \leq \lambda < 1, \lambda'(c) > 0$ and $\lambda''(c) < 0$. According to equation 9, the solution is from the following function group,

$$\begin{cases} (e^{-c}/r)\int_w^A [(x-w)/A]dx = 1 & \text{(i)} \\ [(1-e^{-c})/r]\int_w^A [(x-w)/A]dx = c + w^* - b & \text{(ii)} \end{cases} \qquad \text{(A1.1)}$$

From function (i),

[7] The distribution of job offer and function form of job arrival rate are cited from Moshe Ben-Horim and Dror Zuckerman (1986)

$$\int_w^A [(x-w)/A]dx = (A-w)^2/2A = re^c \qquad \text{(A1.2)}$$

Substitute equation A1.2 to the equation (ii) of equation group A1.1,

$$w = e^c + b - c - 1 \qquad \text{(A1.3)}$$

Substitute equation A1.3 back into A1.2,

$$(e^c + b - A - c - 1)^2 = 2Are^c \qquad \text{(A1.4)}$$

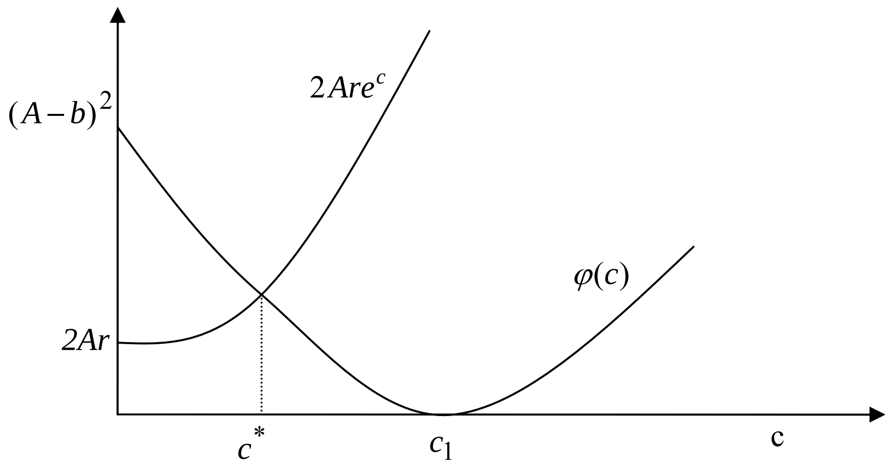
It is very hard to explicitly express the solution of optimal search cost, a figure will be drawn to show whether the solution exists. Let $\varphi(c)$ denote the left-hand side of equation A1.4, that is, $\varphi(c) = (e^c + b - A - c - 1)^2$, then

$$\varphi'(c) = 2(e^c + b - A - c - 1)(e^c - 1) \qquad \text{(A1.5)}$$

As $c \geq 0$, $e^c - 1 \geq 0$. In order to determine the sign of $\varphi'(c)$, the sign of $(e^c + b - A - c - 1)$, or equivalently $\{e^c - [c + 1 + (A - b)]\}$ must be determined. If A>b, it can be found that the sign of $(e^c + b - A - c - 1)$ is negative when c is below certain amount, suppose c_1 satisfies $(e^c + b - A - c - 1) = 0$ and the sign becomes positive when c is above c_1. Totally, $\varphi'(c)$ firstly is negative when $c < c_1$ and then positive when $c > c_1$.

From figure A1 it is clear that if $(A-b)^2 > 2Ar$ the optimal search cost c^* does exist. Numerical method can be used to compute the value of c^* and then the optimal reservation wage or the maximized value of unemployment can be got.

Figure A1 The solution of optimal search cost



A.2 The Effect of UI Benefits on Optimal Search Cost

Using this example, the optimal search cost in case of UI benefits can be determined. UI benefits are taken as part of value of leisure-that is, b changes to $b+u$. Hence the curve $\varphi(c)$ shifts down, causing the optimal search cost to decrease.

Appendix 2

COMPUTATION METHOD OF EMRIRICAL HAZARD RATE

Let n_j be the number of spells neither completed nor censored before duration t_j. Let m_j and h_j be the number of spells censored and completed respectively at time t_j, then

$$n_j = \sum_{t_i \geq t_j}^{K} (m_i + h_i) \qquad \text{(A2.1)}$$

The hazard $h(t_j)$ is the probability of completing a spell at duration t_j, conditional upon the spells reaching duration t_j. A natural estimator for $\phi(t_j)$ is

$$\phi(t_j) = \frac{h_j}{n_j} \qquad \text{(A2.2)}$$

Following the Kaplan-Meier method

$$\overline{K}(t_j) = \prod_{i=1}^{j} \frac{n_i - h_i}{n_i} = \prod_{i=1}^{j} (1 - \phi(t_i)) \qquad \text{(A2.3)}$$

This is the well-known Kaplan-Meier survival rate estimation.

APPENDIX 3

UNEMPLOYMENT BENEFITS SYSTEM OF UNITED STATES

In United States, UI is the main form of unemployment benefits for unemployed people. It is a compulsory insurance system. Employees of firms in industry and commerce and employees of nonprofit organizations with 4 or more employees during 20 weeks in a year are covered by UI. Almost all State and local government workers, domestics, and 2/5 of farm workers are also covered. Some agricultural employees, employees of religious organizations, casual employees, family labor, and self-employed are excluded from access to UI. Special Federal programs for railroad employees, Federal employees, and ex-service persons are also set up in other laws.

A worker's monetary benefits rights are based on his or her employment in covered work over a prior period, called the "base period", and these benefit rights remain fixed for a "benefit year". In most States the base period is the four quarters of the last five completed calendar quarters before the claim of UI. About 3/4 of States require minimum earnings in preceding base year equal to specified multiple of weekly benefit or high-quarter wages, or to specified total amount. Eight States require a specified number of weeks of employment (e.g., 15-20 weeks) (minimum number of hours in one state), generally reinforced by a requirement of an average or minimum amount of wages per week.

In addition, all States require that for claimants to receive benefits, they must be able to work and must be available for work, that is, they must be in the labor force and their unemployment must be due to lack of work. One kind of evidence of ability to work is filling of claims and registration for work at States agencies, also the unemployed worker is required to make an independent job-seeking effort. Most states also have special disqualification provisions. Unemployment due to voluntary leaving, misconduct, labor dispute, or refusal of suitable offer (length of disqualification varies among States) will not be covered by UI.

Under all states laws, the amount payable for a week of total unemployment varies with the worker's past wages within minimum and maximum limits. In most of the states, the formula is designed to compensate for a fraction of the usual weekly wage (normally about 50%), subject to specified dollar maximums. All states pay the full weekly benefits amount when a claimant has some work during the week, but has earned less than a specified (relatively small) sum. In the majority of states, this amount is defined as a wage that is earned in a week of less than full-time work and that is less than the claimant's regular weekly benefit amount. All states also provide for the payment of reduced weekly benefits, partial payment, when earnings exceed that specified amount. Twelve states and the District of Columbia provide additional allowance for certain dependants. They all include children under specified ages (16, 18, or 19 and generally, older if incapacitated); nine states provide for a nonworking spouse; and three states cover other dependant relatives.

Most states require a waiting period of one week before benefits can begin. All but two states set a statutory maximum of 26 weeks of benefits in a benefits year. In addition, most states vary the duration of benefits through formulas that relate potential duration to the amount of former earnings or employment.

In the 1970's, a permanent Federal-State program of extended benefits was established for workers who exhaust their entitlement to regular benefits during high unemployment. Once the extended benefit is triggered, Federal law provides up to 13 additional weeks in States with high unemployment. The federal law requires that the claimant applying for extended benefits must have 20 weeks in full-time employment (or equivalent in insured wages) and must meet special work requirement.